iSMA-B-MIX18

BACnet

User Manual

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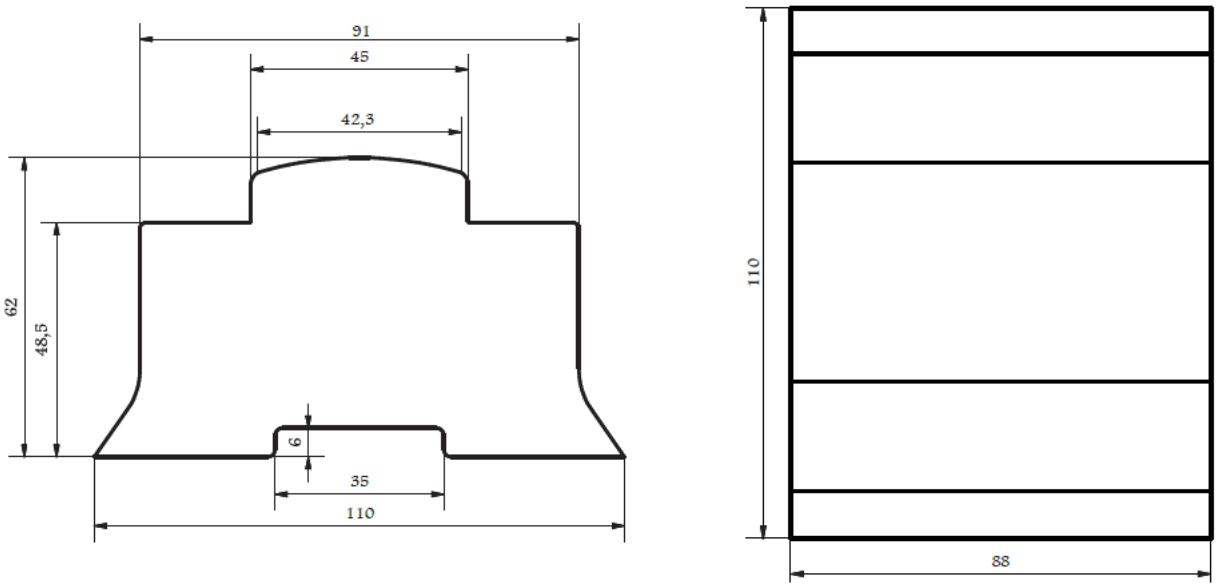
1. Safety rules.

- Note incorrect wiring of this product can damage it and lead to other hazards. Make sure the product has been correctly wired before turning the power ON.
- Before wiring, or removing / mounting the product, be sure to turn the power OFF. Failure to do so might cause electric shock.
- Do not touch electrically charged parts such as the power terminals. Doing so might cause electric shock.
- Do not disassemble the product. Doing so might cause electric shock or faulty operation.
- Use the product within the operating ranges recommended in the specification (temperature, humidity, voltage, shock, mounting direction, atmosphere etc.). Failure to do so might cause fire or faulty operation
- Firmly tighten the wires to the terminal. Insufficient tightening of the wires to the terminal might cause fire.

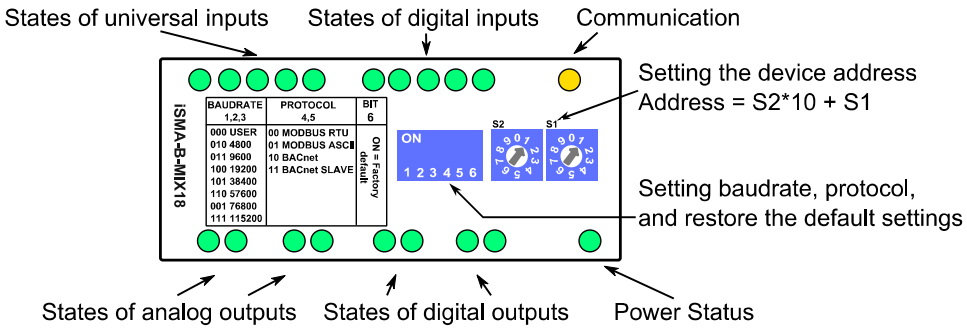
2. Technical specifications

Power supply	Voltage	24V AC/DC ± 20%
	Power consumption	3W @ 24VDC; 4.5VA @ 24VAC
Universal Inputs	No. of inputs	5
	Temperature input	Measurement with attached RTDs accuracy 0.1˚C
	Voltage input	Voltage measurement from 0 to 10V Input impedance 100kΩ measurement accuracy ±1mV
	Resistive input	Measurement of resistance from 0 to 1000kΩ
	Resistance measurement method	The voltage divider
	Dry contact input	Output current ~1mA
	Measurement resolution	12 bits (default) or 16 bits
	Processing time	10ms/channel at 12 bits 140ms/ channel at 16 bits
Digital Inputs	No. of inputs	5
	Type	Dry contact
	Max input frequency	100Hz
Analog Outputs	No. of outputs	4
	Voltage range	0 to 10V
	Max. load current	20mA
	Resolution	12 bits
	Accuracy	±0.5%
Digital Outputs (relays)	No. of outputs	4
	Resistive load	3A @ 230VAC or 3A @ 30VDC
	Inductive load	75VA @ 230VAC or 30W @ 30VDC
Interface	RS485	Up to 128 devices
	Communication protocol	Modbus RTU, Modbus ASCII, BACnet or BACnet SLAVE set by switch
	Baud rate	From 2400 to 115200 set by switch
	Address	0 to 99 set by switch
Ingress protection	IP	IP40
Temperature	Storage	– 40˚C to +85˚C
	Operating	– 10˚C to +50˚C
Humidity	Relative	5 to 95%
Connectors	Type	Removable
	Maximum cable size	2.5 mm^2
Dimension	Width	110 mm
	Length	88 mm
	Height	62 mm

3. Size



4. LED Indicators



- The power LED is ON (green) when the module is running properly.
- Communication LED is ON (orange) for 20 ms after sending each message. If the module receives / sends a lot of messages LED can be lit continuously.
- LEDs indicate the status of the universal inputs are lit when resistance connected to the input is less than 1kΩ (Dry Contact input is active). Caution! The LED also lights up when voltage connected to the input has a very low potential.
- LEDs indicate the status of the digital inputs are lit when the input is active.
- LEDs indicate the status of the analog outputs are lit when output voltage or PWM factor is different from 0.
- LEDs indicate the status of the digital outputs are lit when output is enabled.

5. Grounding and shielding

In most cases, IO modules will be installed in an enclosure along with other devices which generate electromagnetic radiation. Examples of these devices are relays, contactors, transformers, motor invertors etc. This electromagnetic radiation can induce electrical noise into both power and signal lines, as well as direct radiation into the module causing negative effects on the system. Appropriate grounding, shielding and other protective steps should be taken at the installation stage to prevent these effects. These protective steps include control cabinet grounding, cable shield grounding, protective elements for electromagnetic switching devices, correct wiring as well as consideration of cable types and their cross sections.

6. Network Termination

Transmission line effects often present a problem on data communication networks. These problems include reflections and signal attenuation.

To eliminate the presence of reflections from the end of the cable, the cable must be terminated at both ends with a resistor across the line equal to its characteristic impedance. Both ends must be terminated since the direction of propagation is bidirectional. In the case of an RS485 twisted pair cable this termination is typically 120 Ω.

7. Setting Module MAC

To determine the MAC of module, module provides two rotary switches S1 and S2 located on the top panel device.

It is possible to set the MAC from 0 to 99 in BACnet protocol mode or from 128 to 227 in BACnet SLAVE protocol mode (128 + switch value).

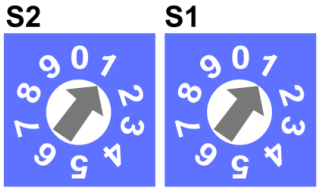
Changing the MAC address is instantaneous. No restart is required.

The formula for setting the MAC:

MAC = S2 • 10 + S1

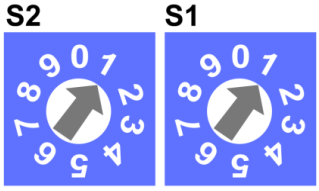
Where S1 and S2 are values of switches.

Example for BACnet protocol mode:



Switch sets as in the picture above will set the module MAC to 11.

Example for BACnet SLAVE protocol mode:



Switch sets as in the picture above will set the module MAC to 139 (128+11).

8. Setting Device ID

Formula for Device ID:

DeviceID = VendorID*1000 + MAC + 128(Only in BACnet SLAVE)

Where VendorID = 680.

Example: If MAC is set to 41 and BACnet protocol than DeviceID = 680041 or if in BACnet SLAVE than DeviceID = 680169

If user change Device ID (by setting a new value of Device ID property in Device object) then change of MAC does not change Device ID. Restore the default behaviour occurs with the restoration of the default settings (11 **Błąd! Nie można odnaleźć źródła odwołania.**).

9. Communication baud rate selection

Transmission baud rate is determined by S3 switch (sections 1, 2 and 3) in accordance with the following table:

1	2	3	Baud rate
OFF (0)	OFF (0)	OFF (0)	76800
OFF (0)	OFF (0)	ON (1)	2400
OFF (0)	ON (1)	OFF (0)	4800
OFF (0)	ON (1)	ON (1)	9600
ON (1)	OFF (0)	OFF (0)	19200
ON (1)	OFF (0)	ON (1)	38400
ON (1)	ON (1)	OFF (0)	57600
ON (1)	ON (1)	ON (1)	115200

10. Protocol selection

Protocol selection is done by sections 4 and 5 of the S3 switch according to following table:

4	5	Protocol
OFF (0)	OFF (0)	Modbus RTU
OFF (0)	ON (1)	Modbus ASCII
ON (1)	OFF (0)	BACnet
ON (1)	ON (1)	BACnet SLAVE [1]

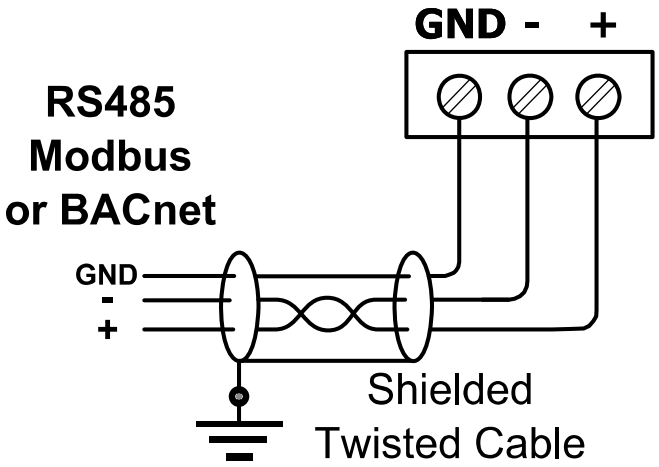
[1] BACnet SLAVE does not support discover function.

11. Restoring the default settings

To restore the default configuration of all registers, follow the steps below:

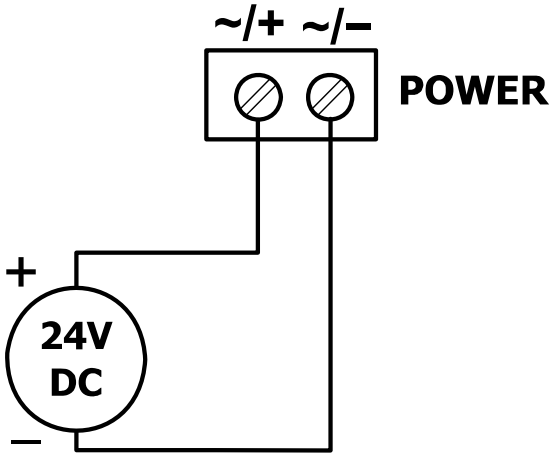
1. Turn off power supply
2. Set section 6 of S3 switch to ON
3. Turn on power supply, power LED blinking
4. Switch section 6 of S3 switch to OFF to restore the default settings. To cancel the reset, turn off the power and switch section 6 of S3 switch to the OFF position.

12. Connecting the communication bus

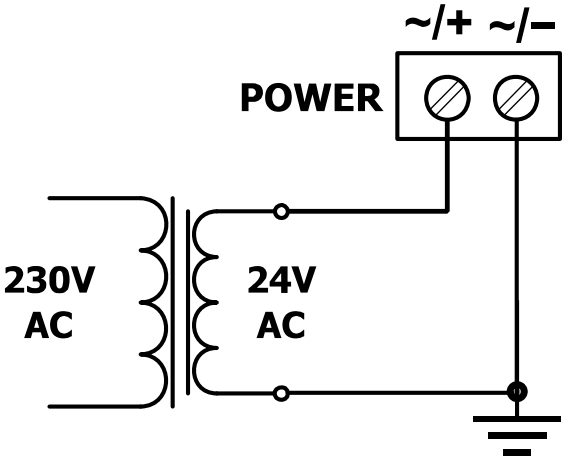


13. Power supply connection

13.1. DC power connection



13.2. AC power connection



14. Protocol implementation conformance statement

14.1. BACnet Protocol Implementation Conformance Statement

Date	2013-09-26
Vendor Name	ISM EuroCenter S.A.
Product Name	iSMA-B-MIX
Product Model Number	iSMA-B-MIX18
Firmware Revision	0.8.0
BACnet Protocol Revision	1.12

14.2. BACnet Standardized Device Profile

BACnet Smart Sensor (B-SS)

14.3. BACnet Interoperability Building Blocks Supported

Application Service (B-SS)	Designation
Data Sharing - Read Property - B	DS-RP-B
Data Sharing - Write Property - B	DS-WP-B
Device Management - Dynamic Device Binding - B	DM-DDB-B
Device Management - Dynamic Object Binding - B	DM-DOB-B
Data Sharing - Read Property Multiple - B	DS-RPM-B
Data Sharing - Write Property Multiple - B	DS-WPM-B

14.4. BACnet Standard Object Types Supported

The following is a list of the standard object types as defined by ASHRAE.

Object Name	Object Numbers
Analog Input	5
Analog Output	4
Binary Input	5
Binary Output	4
Device	1

14.5. Data Link Layer Option

Master-Slave/Token-Passing (MS/TP) master (Clause 9), baud rates: 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200.

14.6. Character Sets Supported

ANSI X3.4

14.7. Supported Application Services

Application Service	Initiates Requests	Executes Requests
I-Am	yes	
I-Have	yes	
ReadProperty		yes
ReadPropertyMultiple		Yes
Who-Has		yes
Who-Is		yes
WriteProperty		yes
WritePropertyMultiple		yes

15. Device (iSMA-B-MIX18)

15.1. BACnet object description

Dynamically Creatable: No, Dynamically Deletable: No

Property Name	Required	Proprietary	Writeable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	yes					iSMA-B-MIX18
OBJECT_NAME	yes					
OBJECT_TYPE	yes					
SYSTEM_STATUS	yes					
VENDOR_NAME	yes					
VENDOR_IDENTIFIER	yes					
MODEL_NAME	yes					
FIRMWARE_REVISION	yes					
APPLICATION_SOFTWARE_VERSION	yes					
PROTOCOL_VERSION	yes					
PROTOCOL_REVISION	yes					
PROTOCOL_SERVICES_SUPPORTED	yes					
PROTOCOL_OBJECT_TYPES_SUPPORTED	yes					
OBJECT_LIST	yes					
MAX_APDU_LENGTH_ACCEPTED	yes					
SEGMENTATION_SUPPORTED	yes					
APDU_TIMEOUT	yes					
NUMBER_OF_APDU_RETRIES	yes					
MAX_MASTER	yes		yes			
MAX_INFO_FRAMES	yes					
DEVICE_ADDRESS_BINDING	yes					
DATABASE_REVISION	yes					
WATCHDOG		yes	yes	5001	Unsigned	15.2 WATCHDOG property
VALID_FRAMES_FOR_US_CNT		yes		5101	Unsigned	
VALID_FRAMES_NOT_FOR_US_CNT		yes		5102	Unsigned	
ERROR_FRAMES_CNT		yes		5103	Unsigned	
TRANSMITTED_FRAMES_CNT		yes		5104	Unsigned	

15.2. WATCHDOG property

This property specifies the time in seconds to watchdog reset. If module does not receive any valid BACnet message within that time, all PRIORITY_ARRAYs will be set to null and PRESENT_VALUE for outputs will be set to RELINQUISH_DEFAULT value.

This feature is useful if for some reason there is an interruption in data transmission and for security reasons output states must be set to the appropriate state endanger the safety of persons or property.

A setting of 0 will disable the watchdog. The default value is 15 seconds.

15.3. VALID_FRAMES_FOR_US_CNT property

This property contains number of valid frames (on MS/TP layer) addressed to this module.

15.4. VALID_FRAMES_FOR_NOT_US_CNT property

This property contains number of valid frames (on MS/TP layer) but not addressed to this module.

15.5. ERROR_FRAMES_CNT property

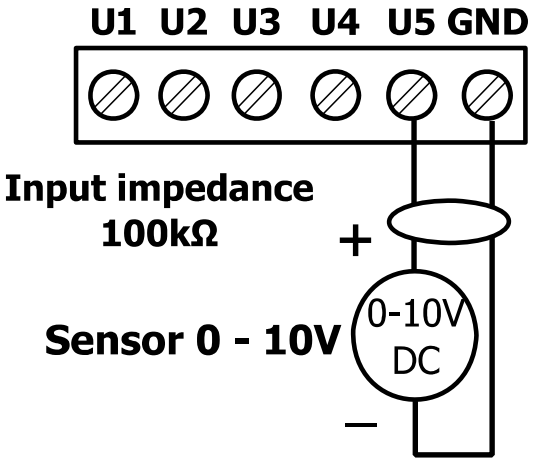
This property contains number of invalid frames on MS/TP layer.

15.6. TRANSMITTED_FRAMES_CNT property

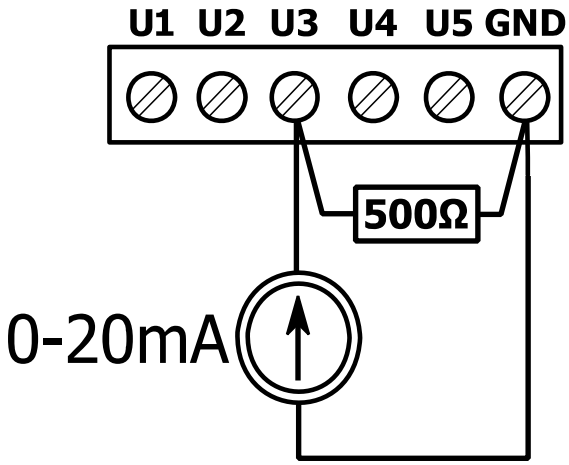
This property contains number of transmitted frames.

16. Universal Inputs

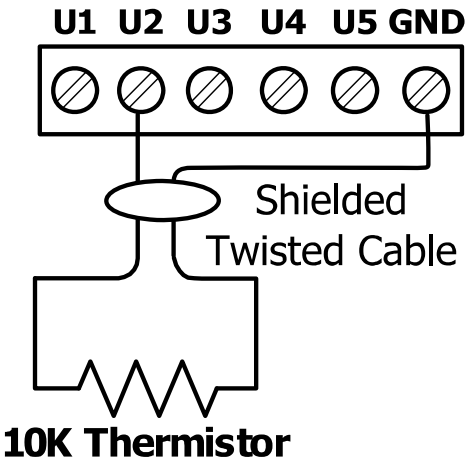
16.1. Connection of universal input to measure voltage 0 – 10V



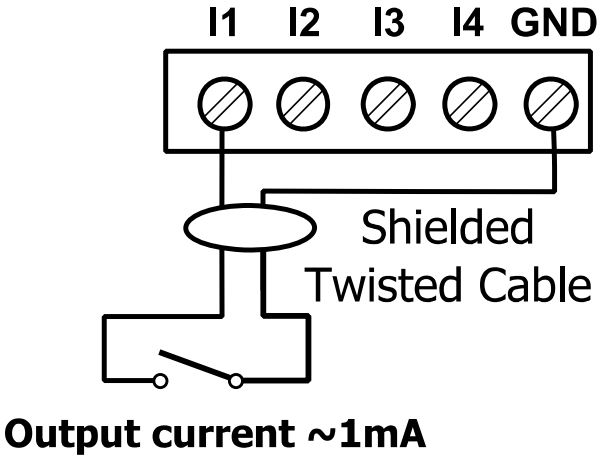
16.2. Connection of universal input to measure current 0 – 20mA



16.3. Connection of universal input to measure temperature



16.4. Connection of universal input as a digital input (Dry Contact)



16.5. BACnet object description

Dynamically Creatable: No, Dynamically Deletable: No

Property Name	Required	Proprietary	Writeable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	yes					from UI-1 to UI-5
OBJECT_NAME	yes					
OBJECT_TYPE	yes					
PRESENT_VALUE	yes					16.6 PRESENT_VALUE and UNITS Property
STATUS_FLAGS	yes					
EVENT_STATE	yes					
OUT_OF_SERVICE	yes					
UNITS	yes					16.6 PRESENT_VALUE and UNITS Property
INPUT_TYPE		yes	yes	4001	Enumerated	16.7 INPUT_TYPE Property
RESOLUTION		yes	yes	4002	Enumerated	16.9 RESOLUTION Property
FILTER		yes	yes	4003	Unsigned	16.8 FILTER Property
VOLTAGE		yes		3010	Unsigned	16.10 VOLTAGE Property
RESISTANCE		yes		3012	Unsigned	16.11 RESISTANCE Property
DRY_CONTACT		yes		3013	Enumerated	16.12 DRY_CONTACT Property

16.6. PRESENT_VALUE and UNITS Property

This properties contain actual value and unit of universal input according to INPUT_TYPE property value.

16.7. INPUT_TYPE Property

This property is used to configure a universal input in accordance with the following table:

Property value	Description
0	Voltage measuring 0-10V
1 (default)	The temperature sensor 10K3A1 NTC B=3975K
2	The temperature sensor 10K4A1 NTC B=3695K
3	The temperature sensor 10K NTC B=3435K Carel
4	The temperature sensor 20K6A1 NTC B=4262K
5	The temperature sensor 2,2K3A1 NTC B=3975K
6	The temperature sensor 3K3A1 NTC B=3975K
7	The temperature sensor 30K6A1 NTC B=4262K
8	The temperature sensor SIE1
9	The temperature sensor TAC1
10	The temperature sensor SAT1
16	The temperature sensor Pt1000
17	The temperature sensor Ni1000
254	Resistance input
255	Dry Contact input

16.8. FILTER Property

Property with a time constant low pass filter. The value is expressed in seconds. Valid values must be between 0 and 60 seconds. The default filter value is 2 seconds.

16.9. RESOLUTION Property

This property is used to determine the bit resolution for each universal input.

Setting the value to 0 will set the resolution of converter to 12 bit. Setting the value to 1 sets the resolution of converter to 16-bit.

Caution! Setting 16-bit resolution increases measurement time of one channel from 10ms to 140ms. Total time taken to measure all the channels increases from 80ms to 1120ms.

16.10. VOLTAGE Property

Value of this property is the results of the voltage measurement for input. The result is expressed in mV.

16.11. RESISTANCE Property

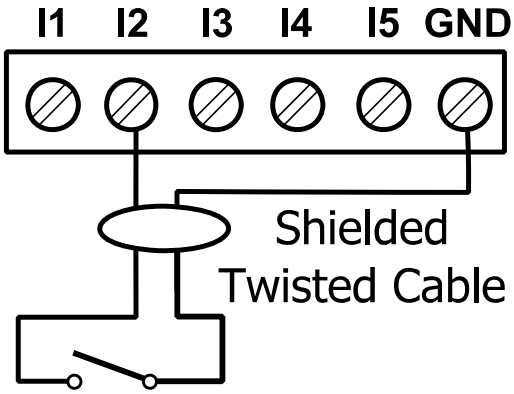
Value of this property is the results of the resistance measurement for input. The result is expressed in Ω.

16.12. DRY_CONTACT Property

Value of this property contains information about the status of digital inputs (dry contact). Short the input to ground will set value to 1.

17. Digital inputs

17.1. Connection of digital input (Dry Contact)



Output current ~1mA

17.2. BACnet object description

Dynamically Creatable: No, Dynamically Deletable: No

Property Name	Required	Proprietary	Writeable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	yes					from DI-1 to DI-5
OBJECT_NAME	yes					
OBJECT_TYPE	yes					
PRESENT_VALUE	yes					17.3 PRESENT_VALUE Property
STATUS_FLAGS	yes					
EVENT_STATE	yes					
OUT_OF_SERVICE	yes					
POLARITY	yes					
UNITS	yes					
COUNTER		yes	yes	3001	unsigned	17.4 COUNTER Property

17.3. PRESENT_VALUE Property

This property contains the status of the digital inputs. Short-circuiting the input to GND sets the value to 1.

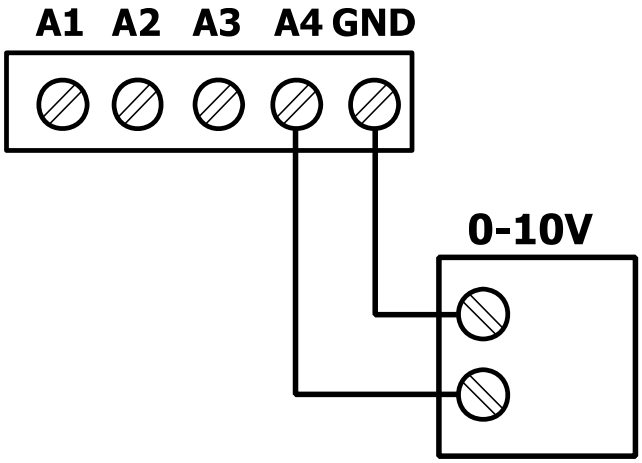
17.4. COUNTER Property

This property contains number of counted pulses.

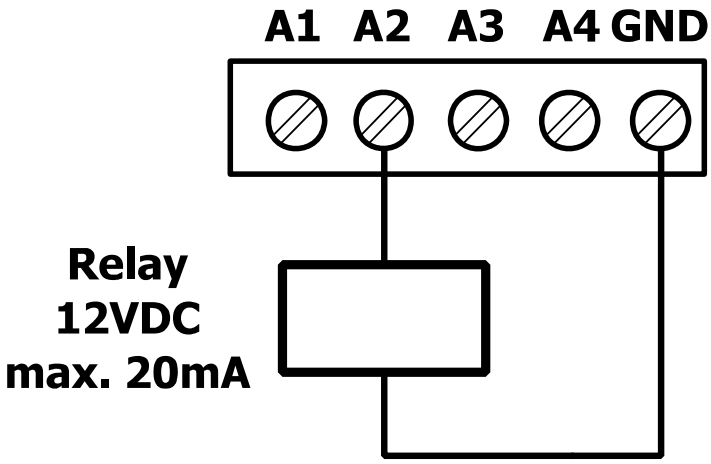
In the case you would like to change the value of the property you can write any value (called preset). In the particular case, you can reset the counter by entering 0.

18. Analog output

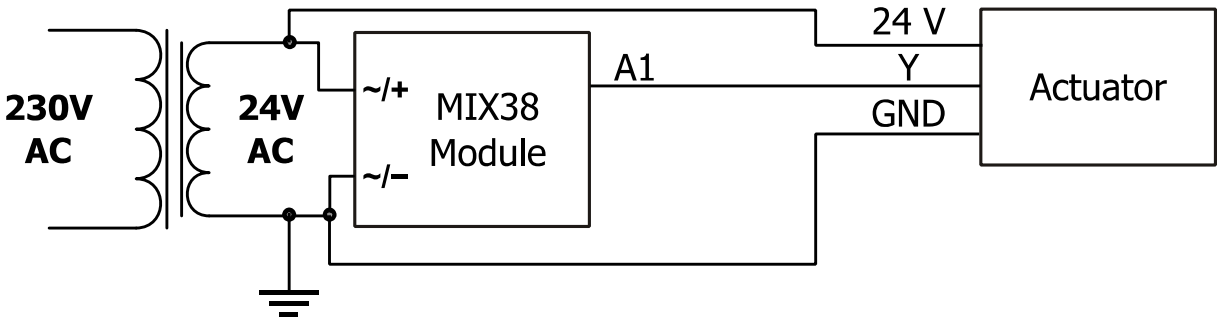
18.1. Connection of analog output 0 – 10V



18.2. Connecting relay to analog output



18.3. Connecting actuator to analog output



18.4. BACnet object description

Dynamically Creatable: No, Dynamically Deletable: No

Property Name	Required	Proprietary	Writeable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	yes					from AO-1 to AO-4
OBJECT_NAME	yes					
OBJECT_TYPE	yes					
PRESENT_VALUE	yes		yes			18.5 PRESENT_VALUE property
STATUS_FLAGS	yes					
EVENT_STATE	yes					
OUT_OF_SERVICE	yes					
UNITS	yes					
PRIORITY_ARRAY	yes					
RELINQUISH_DEFAULT	yes		yes			
OUTPUT_TYPE		yes	yes	4001	enumerated	18.6 OUTPUT_TYPE Property

18.5. PRESENT_VALUE property

In the property is stored value in mV of voltage that appears at the analog output.

If OUTPUT_TYPE Property is set to PWM than PRESENT_VALUE contains duty cycle (in percentage) of output PWM signal.

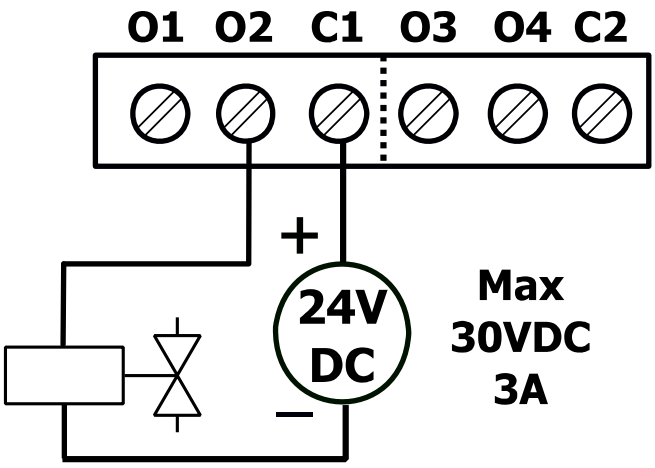
18.6. OUTPUT_TYPE Property

This property contain information about the mode of the analog output according to following table:

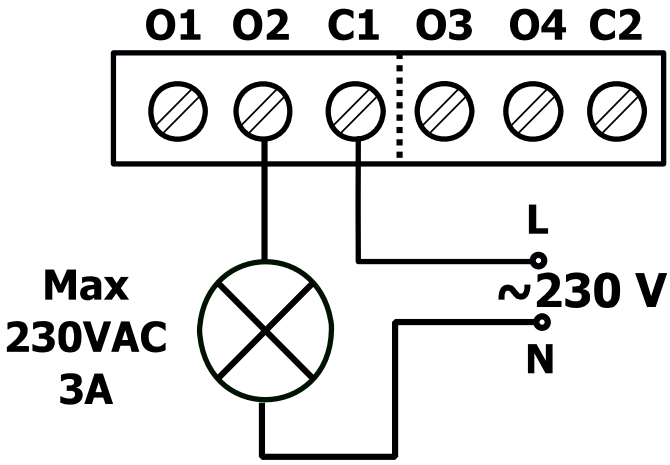
Property value	Description
0 (default)	Voltage output 0 – 10V
1	PWM 1Hz
2	PWM 10Hz
3	PWM 100Hz

19. Digital outputs (relays)

19.1. Connecting the solenoid valve to the digital output



19.2. Connecting a resistive load to the digital output



19.3. BACnet object description

Dynamically Creatable: No, Dynamically Deletable: No

Property Name	Required	Proprietary	Writeable	Property ID	Data Type	Description
OBJECT_IDENTIFIER	yes					from DO-1 to DO-12
OBJECT_NAME	yes					
OBJECT_TYPE	yes					
PRESENT_VALUE	yes		yes			
STATUS_FLAGS	yes					
EVENT_STATE	yes					
OUT_OF_SERVICE	yes					
POLARITY	yes					
PRIORITY_ARRAY	yes					
RELINQUISH_DEFAULT	yes		yes			

20. List of objects properties

Object	Property Name	Writeable	Property ID	Data Type	Description
Device (iSMA-B-MIX18)	WATCHDOG	Yes	5001	Unsigned	Time in seconds to watchdog reset.
	VALID_FRAMES_FOR_US_CNT		5101	Unsigned	Number of valid frames addressed to module
	VALID_FRAMES_NOT_FOR_US_CNT		5102	Unsigned	Number of valid frames but not addressed to module
	ERROR_FRAMES_CNT		5103	Unsigned	Number of invalid frames
	TRANSMITTED_FRAMES_CNT		5104	Unsigned	Number of transmitted frames
Universal Input (UI-1 ÷ UI-5)	PRESENT_VALUE				Measured value of universal input according to INPUT_TYPE property value.
	INPUT_TYPE	yes	4001	Enumerated	Used to configure a universal input in accordance with the table in 16.7 INPUT_TYPE Property
	RESOLUTION	yes	4002	Enumerated	Resolution of converter: 0 – 12 bits 1 – 16 bits
	FILTER	yes	4003	Unsigned	Lowpass filter time constant in seconds
	VOLTAGE		3010	Unsigned	Universal input voltage in mV
	RESISTANCE		3012	Unsigned	Universal input resistance in Ω
	DRY_CONTACT		3013	Enumerated	Status of digital input (dry contact). Short the input to ground will set value to 1.
Digital Input (DI-1 ÷ DI-5)	PRESENT_VALUE				Status of the digital inputs. Short the input to ground will set value to 1.
	COUNTER	yes	3001	Unsigned	Number counted of pulses
Analog Output (AO-1 ÷ AO-4)	PRESENT_VALUE	yes			Analog output value in mV if OUTPUT_TYPE set to 0 Analog output value in % if OUTPUT_TYPE set to 1-3
	OUTPUT_TYPE	yes	4001	Enumerated	Mode of the analog output according to following table:
					Property value / **Description**
					0 (default) / Voltage output 0 – 10V
					1 / PWM 1Hz
					2 / PWM 10Hz
					3 / PWM 100Hz
Digital Output (DO-1 ÷ DO-4)	PRESENT_VALUE	yes			State of digital output

21. List of supported temperature sensors

No	1	No	2
Sensor	10K3A1	Sensor	10K4A1
β coeffictient	3975K	β coeffictient	3695K
Manufacturers	Aquatrol, Cylon, Honeywell, Johnson, Satchwell, Seachange	Manufacturers	Andover, Delta Controls, Siebe, York
°C	Ω	°C	Ω
–50	667828	–50	441667
-45	491749	-45	330749
–40	335671	–40	239831
-35	241840	-35	181532
–30	176683	–30	135233
-25	131251	-25	105081
–20	96974	–20	78930
–15	72895	–15	61030
–10	55298	–10	47549
–5	42314	–5	37316
0	32650	0	29490
5	25396	5	23462
10	19904	10	18787
15	15714	15	15136
20	12494	20	12268
25	10000	25	10000
30	8056	30	8197
35	6530	35	6754
40	5325	40	5594
45	4367	45	4656
50	3601	50	3893
55	2985	55	3271
60	2487	60	2760
65	2082	65	2339
70	1751	70	1990
75	1480	75	1700
80	1256	80	1458
85	1070	85	1255
90	916	90	1084
95	787	95	939
100	678	100	817
105	587	105	713
110	510	110	624
115	444	115	547
120	388	120	482
125	340	125	426

No	3	No	4
Sensor	10K Carel	Sensor	20K6A1
β coeffictient	3435K	β coeffictient	4262K
–50	329500	Manufacturers	Honeywell
-45	247700	°C	Ω
–40	188500	–40	806800
-35	144100	-35	574400
–30	111300	–30	413400
-25	86430	-25	300400
–20	67770	–20	220600
–15	53410	–15	163480
–10	42470	–10	122260
–5	33900	–5	92220
0	27280	0	70140
5	22050	5	53780
10	17960	10	41540
15	14690	15	32340
20	12090	20	25340
25	10000	25	20000
30	8313	30	15886
35	6940	35	12698
40	5827	40	10212
45	4912	45	8260
50	4161	50	6718
55	3536	55	5494
60	3020	60	4518
65	2588	65	3732
70	2228	70	3098
75	1924	75	2586
80	1668	80	2166
85	1451	85	1823
90	1266	90	1541
95	1108	95	1308
100	973	100	1114
105	857	105	953
110	758	110	818
115	672	115	704
120	597	120	609
125	531	125	528

No	5	No	6
Sensor	2.2K3A1	Sensor	3K3A1
β coeffictient	3975K	β coeffictient	3975K
Manufacturers	Ambiflex, Johnson	Manufacturers	Alerton
°C	Ω	°C	Ω
–50	329500	–50	200348
-45	247700	-45	150524
–40	188500	–40	100701
-35	144100	-35	76853
–30	111300	–30	53005
-25	86430	-25	41048
–20	67770	–20	29092
–15	53410	–15	21868
–10	42470	–10	16589
–5	33900	–5	12694
0	27280	0	9795
5	22050	5	7619
10	17960	10	5971
15	14690	15	4714
20	12090	20	3748
25	10000	25	3000
30	8313	30	2417
35	6940	35	1959
40	5827	40	1598
45	4912	45	1310
50	4161	50	1080
55	3536	55	896
60	3020	60	746
65	2588	65	625
70	2228	70	526
75	1924	75	444
80	1668	80	377
85	1451	85	321
90	1266	90	275
95	1108	95	236
100	973	100	204
105	857	105	176
110	758	110	153
115	672	115	133
120	597	120	117
125	531	125	102

No	7	No	8
Sensor	30K6A1	Sensor	SIE1
β coeffictient	4262K	Manufacturers	Barber Colman, Siebe
Manufacturers	Drayton	°C	Ω
°C	Ω	−50	10732
−30	622911	-45	10624
-25	477393	−40	10517
−20	331876	-35	10344
−15	245785	−30	10172
−10	183697	-25	9913
−5	138502	−20	9654
0	105305	−15	9320
5	60713	−10	8933
10	62347	−5	8496
15	48511	0	8044
20	38019	5	7489
25	30000	10	6938
30	23828	15	6370
35	19046	20	5798
40	15317	25	5238
45	12390	30	4696
50	10079	35	4185
55	8243	40	3707
60	6777	45	3271
65	5600	50	2875
70	4650	55	2521
75	3879	60	2206
80	3251	65	1929
85	2737	70	1685
90	2313	75	1472
95	1963	80	1287
100	1672	85	1127
105	1430	90	986
110	1228	95	866
115	1058	100	760
120	915	105	670
125	793	110	590
		115	522
		120	462
		125	410

No	9	No	10
Sensor	TAC1	Sensor	SAT1
β coeffictient	3500K	Manufacturers	Satchwell
Manufacturers	TAC	°C	Ω
°C	Ω	−50	9719
−40	39024	-45	9652
-35	29358	−40	9584
−30	22284	-35	9467
-25	17073	−30	9349
−20	13192	-25	9159
−15	10276	−20	8968
−10	8068	−15	8708
−5	6382	−10	8396
0	5085	−5	8031
5	4078	0	7614
10	3294	5	7150
15	2676	10	6649
20	2188	15	6121
25	1800	20	5580
30	1488	25	5039
35	1237	30	4513
40	1034	35	4012
45	869	40	3545
50	733	45	3117
55	622	50	2730
60	529	55	2386
65	453	60	2082
70	389	65	1816
75	335	70	1585
80	290	75	1385
85	252	80	1213
90	220	85	1064
95	192	90	937
100	169	95	828
105	149	100	734
110	131	105	654
115	116	110	585
120	103	115	525
125	92	120	474
		125	429

No	16	No	16
Sensor	Pt1000	Sensor	Pt1000
Manufacturers	Honeywell, Sauter, Serck, Siebe, Cylon	Manufacturers	Honeywell, Sauter, Serck, Siebe, Cylon
°C	Ω	°C	Ω
-50	803	310	2156
-40	843	320	2192
-30	882	330	2227
-20	922	340	2262
-10	961	350	2297
0	1000	360	2332
10	1039	370	2367
20	1078	380	2402
30	1117	390	2436
40	1155	400	2471
50	1194		
60	1232	No	17
70	1271	Sensor	Ni1000
80	1309	Manufacturers	Sauter
90	1347	°C	Ω
100	1385	-50	743
110	1423	-40	791
120	1461	-30	841
130	1498	-20	893
140	1536	-10	946
150	1573	0	1000
160	1611	10	1056
170	1648	20	1112
180	1685	30	1171
190	1722	40	1230
200	1759	50	1291
210	1795	60	1353
220	1832	70	1417
230	1868	80	1483
240	1905	90	1549
250	1941	100	1618
260	1977	110	1688
270	2013	120	1760
280	2049	130	1833
290	2085	140	1909
300	2121	150	1987